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PRODUCTION OF BAMBOO AND BAMBOO PULP : ITS IMPORTANCE IN THE SOUTH-EAST ASIA

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PRODUCTION OF BAMBOO AND BAMBOO PULP
- Its Importance in the South-East Asia -

I. BAMBOO RESOURCES
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II. PRODUCTION OF BAMBOO PULP
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I. BAMBOO RESOURCES

1. The total surface area of bamboo distribution in the South-East Asian countries may be as large as 10 million ha. There exist a large number of species, and not a few species of genera, Bambusa, Dendrocalamus, Melocanna, Oxythenanthera, Schizostachyum, and Teinostachyum, offer ideal material for pulp production.
2. Most of the tropical species are of sympodial type. Many of their clumps stand in clump form, while some stand in single culm form (Melocanna, etc.). These two forms, however, appear to be interchangeable depending on conditions such as fertility of soil.
3. Let us assume the available surface area of bamboo forests as 5 million ha, and the mean annual bamboo culm production per ha in 2-3 year felling cycle as 3 tons, which is able to yield 1 ton of pulp. Then production of 5 million tons of pulp per year is quite possible.
4. The economical scale of a pulp paper factory generally requires production of at least 50,000 tons of pulp per year. Continuous operation of such a factory will require a group of densely distributed bamboo forests about 50,000 ha in total surface area.
5. In Japan, a bamboo paper making factory had been operated successfully for about 10 years, and produced about 5,000 tons of paper of good quality every year. Though its operation came to be suspended recently due to lack of bamboo resources, it had made considerable contributions to overcoming a number of disadvantages and had done important studies on improving productivity of bamboo forests.
6. New bamboo sprouts complete their growth to full size within a few months showing no further growth thereafter. Therefore, the annual increment per ha is the total sum of culms newly grown within the year. The yearly growth percentage of bamboo forest is as large as 20% with a good management. The most suitable cutting age is in the fourth year of its growth. The turnover percentage of capital in bamboo production is therefore much higher than in lumber production. It is also advantageous that no planting is needed after culms are felled and yielded, as bamboos propagate asexually by rhizomes.
7. These excellent features in growth and propagation, together with the immensity of bamboo forests in the region, make the production of bamboo pulp in the South-East Asia a promising industry. This enterprise will further be supported by its bamboo forests distributed rather conveniently for transportation and relatively flat landscape.
8. The South-East Asian climate also favors bamboo growth. The total length and weight of a culm in the tropical region are superior to those of a culm of

the same size growing in Japan. However, the total volume of bamboo or yearly increment (yield) per ha of a bamboo forest in the South-East Asia is inferior to those in Japan as shown in the following table. This difference is due to the poor management of bamboo forests in the former area.

Culm Yield (Increment) per Year per ha

Country	Species of bamboo	Culm yield (air dry weight)	Investigated by
Japan	Phyllostachys heterocycla var. pubescens	7.0-15.0 tons.	K. Ueda
	Ph. bambusoides	5.0-10.0 "	"
	Dendrocalamus strictus	3.0- 5.0 "	"
India	Bambusa arundinaria	5.0- 6.0 "	"
	Melocanna bambusoides	5.0- 6.0 "	"

9. In utilizing bamboos for pulp, reafforestation must be made as bamboo culms are felled, even if the surface area is large. Improper thinning is bound to lower the productivity of bamboo forests, and results in a marked hindrance on the operation of factories. It is desirable to fell grown-up bamboos in a 2-3 year felling cycle, always reserving young vigorous ones. The influences of the age, size and number of mother bamboos on annual yield have been investigated with radioisotope P^{32} and through other experiments. Fertilizing in summer also proved to be extremely effective in increasing yield in tropical bamboo forests.

10. If bamboo forests are left unattended after a gregarious flowering and death of bamboos, it takes them more than 10 years to recover their original vigor. The writer also conducted a successful research on the cause and proper treatment of flowering and death of bamboos.

11. Breeding bamboos suitable for pulp production is important. The writer and his colleagues have recommended chromosome study, X-ray irradiation, colchicine treatment, low temperature treatment of seeds, and so on.

II. PRODUCTION OF BAMBOO PULP

11. Under the present situation, bamboo pulp together with Bagasse Pulp is one of the essential resources for making paper of which production can be expected to increase in a large quantity in the South-East Asia. Althoughit is blessed with rich resources and a variety of useful bamboos for pulp, the bamboo pulp industry in these countries still remains without showing any remarkable development to speak of at present.

12. For one reason, this is attributable to the fact that the industrialization of these areas itself has been left behind, but for other important reasons, the progressive countries' pulp industries have little use for bamboo and naturally they have lacked knowledge as well as the exact know-how for dealing with bamboos and also for bamboo pulp production. For example, it is rather a matter of wonder that there still exists such an incorrect notion as to regard bamboo pulp in the same light as rice straw pulp.

13. From the view point of pulp resources, we have had theoretically as well as practically a successful results in the investigation and manufacture of bamboo pulp and paper for these past 10 odd years. Further, we have been co-operating in the promotion of several projects for a bamboo pulp industry in Indonesia and Burma etc., and also on obtaining a full knowledge of the circumstances there we have now realized that a bamboo industry in South-East Asia is the one of considerable concern and interest for us.

14. There are not a few new and outstanding discoveries on the physical and chemical properties of bamboo, such facts, in particular, have been made

evident and well-founded theoretically by anatomical analysis that its penetrability to chemical solution is very high, bamboo nodes do not present any impediment to pulping, and that fibre cells of the useful bamboos of South-East Asia are very long not less than "Trachide" of coniferous wood.

15. Furthermore, as the result of the chemical analysis of bamboo and investigations of the construction of components, there has been discovered many precise facts one of which is referred to in studies on the construction of lignin and its content. The contents of cellulose and hemicellulose of bamboo being very high, bamboos are quite adequate as a raw material for what is called holocellulose paper pulp; silica content is not so much.. It has also been shown by a research on polymerization grade and the distribution of bamboo cellulose molecules that bamboo pulp is suitable for rayon pulp.

16. At present the bleached kraft process is the most rational and advantageous one for bamboo among the well-known processes of pulp making, mainly being ascribed to the chemical property of bamboo lignin and its amount of content. Bleaching of bamboo pulp is easy and so-called fractional digestion is not necessary, and bamboo pulp yield as well as its quality is excellent compared with pulp of coniferous wood. Produced by this process, unbleached pulp is fit for making wrapping paper and bleached pulp for writing and printing paper, but for newsprint its process is still to be investigated for the future.

17. For bamboo, on account of its peculiar shape and the physical and chemical characteristics it has, it is not proper to use a woodchipper but necessary to think of a special device for it. We of course have a chipper for this special purpose having a considerably high ability in efficiency, power, as well as in uniformity of chips.

18. And bamboo, due to its form of fibres, has a singularity in the beating technique. Owing to its silica content, alkali recovering will not take place as in wood kraft pulp, but we have succeeded in getting the same rate of recovering as in wood kraft by our specially invented device.

19. Bleached bamboo pulp comes under a high grade one as for making writing or printing paper and would have much to do with development in blending with other pulp.

20. The material unit of bamboo pulp and paper manufacturing is better than that of coniferous wood. Under the present situation of South-East Asia, although there may exist many obstacles in starting a pulp industry such as importation of various materials and sub-materials, training of engineers and tenders, or securing of funds, all of these obstancles and disadvantages can be said to be the same as the developed countries once experienced.

21. Nevertheless, in view of the fact that rich resources, moderate in price, of high market value, and, what is more, in view of the acute shortage prevailing there, this industry in South-East Asia should be facilitated by giving it every assistance as possible.

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